Barnsdale Bar Quarry Western Extension

Gradiometer Survey

October 1996

West Yorkshire Archaeology Service

West Yorkshire Archaeology Service
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Barnsdale Bar Quarry, Western Extension, North Yorkshire

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Gradiometer Survey

by

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(SE 515 145)

Gradiometer Survey

1. Summary

Client

BFI Waste Systems
Cumberland House
Wintersells Road
Byfleet
Surrey
KT14 7AZ

Objectives

To locate the position and extent of archaeological features within the proposal area and to try to characterise the archaeology thus located.

Method

To facilitate these objectives a detailed gradiometer survey was carried out over 1ha which formed part of the proposed western extension area.

A Geoscan FM36 fluxgate gradiometer with an ST1 sample trigger was used for the survey. The data was downloaded in the field to a Compaq laptop portable computer and later processed on an Elonex 486.

Results and Conclusions

Four positive linear anomalies thought to be ditches have been identified. Two of these are probably field boundaries of fairly recent origin while the remaining pair are ditches either side of a trackway of a different, probably earlier, period. Several isolated positive anomalies were also identified. These may be anthropogenic although previous experience on limestone bedrock suggests they are probably natural features.

2. Introduction and Archaeological Background

2.1 The West Yorkshire Archaeology Service was commissioned by BFI Waste Systems to undertake a geophysical survey at a site to the west of the existing quarry at Barnsdale Bar, immediately south of Crab Tree Lane (see Figures 1 & 2). Although the area is not to be quarried the planting of trees for screening would impact on any sub-surface features. This survey is part of the ongoing programme of archaeological works commissioned by BFI as part of the western extension of the quarry.

2.2 The area of survey is situated within a landscape of field systems, trackways and enclosures of probable Iron Age or Romano-British date. However, possible Neolithic surface finds have been recovered from the southern part of the field in which the survey was carried out.

2.3 The land sloped away gradually to the east towards the bottom of a dry valley. The field had recently been harvested and was under short stubble at the time of survey.

3. Fluxgate Gradiometry: technical information and methods

3.1 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches, and the magnetic susceptibility of the geology into which these features have been cut, which causes the most recognisable responses. Other features, such as kilns and ovens, can be more difficult to identify, although their responses are generally stronger than soil filled features. The highest responses are usually due to iron objects and these produce a characteristic response with a rapid change from positive to negative readings (iron "spikes").

3.2 There are a number of methods employing the fluxgate gradiometer. The most basic of these is referred to as scanning and requires the operator to identify responses whilst covering the site in widely spaced traverses. This method is used as a means of selecting areas for detailed survey when only a sample area is required or to map out the full extent of features located during a sample detailed survey.

3.3 In contrast detailed gradiometer survey employs the use of an ST1 Geoscan sample trigger and FM36 fluxgate gradiometer to take readings at 0.5m intervals on zig-zag traverses 1m apart within grids measuring 20m by 20m. This means that 800 readings are taken within each 20m grid square. In-house software (Geocon Version 8) was used to interpolate the "missing" line of data so that 1600 readings in total were obtained for each complete grid. This method was employed during the survey with traverses orientated from north-west to south-east.

4. Results

4.1 The data is presented as a 1:2500 grey scale plot overlaid on an Ordnance Survey base in Figure 1 and at 1:1250 in Figure 2. An interpretation of the data is shown in Figure 3. Grey scale, dot density and X-Y trace plots of the data are shown at a scale of 1:500 as an appendix to the main report. The X-Y trace plot is presented as it enables responses due to ferrous material in the topsoil ("spikes") to be differentiated from potential archaeological responses such as those caused by hearths or kilns.

Fig. 1 1:2500 Site location showing 1993 & 1995 survey data

4.2 The types of response generally detected on a site can be divided into five main categories which are described below:

1. **Iron Spikes (Dipolar Anomalies)**
   These responses are also referred to as dipolar and are caused by buried iron objects. Little emphasis can be given to such responses as iron objects are normally recent in origin on agricultural sites. Some of the strongest responses have been shown in Figure 3.

2. **Rapid, strong variations in magnetic response**
   Also referred to as areas of magnetic disturbance these can be due to a number of different types of feature. They are usually associated with burnt material such as industrial waste or other strongly magnetic material. It is not always easy to determine their date of origin without supporting information. No anomalies of this type were detected during the survey.

3. **Positive, linear responses**
   The strength of these responses varies depending on the underlying geology. They are commonly caused by ancient ditches or more recent drains. Three anomalies of this nature were detected during the survey.

4. **Isolated positive responses**
   These exhibit a magnitude of between 2nT and 300nT and, dependent on the strength of their response, can be due to pits, hearths, ovens or kilns if archaeological in origin. They can also be caused by naturally occurring features on some geologies. It is very difficult to be certain of their archaeological nature without some intrusive means of examining the features. Several anomalies of this type were detected.

5. **Negative linear anomalies**
   These are normally very faint and are commonly caused by features such as plastic water pipes which are much less magnetic than the surrounding soils and geology. No anomalies of this type were detected.

4.3 Three positive linear anomalies, one orientated east to west (Fig. 3 - **A**) and two parallel anomalies running south-west to north-east (Fig. 3 - **B** and **C**), were detected. A fourth, **D**, running north to south intersects with **B** and **C**. Two intermittent anomalies can be seen running east to west at right angles to the direction of traverse.

4.4 Several isolated positive anomalies were detected. These were clustered to the east of Anomalies **B**, **C** and **D**, and either side of Anomaly **A**.

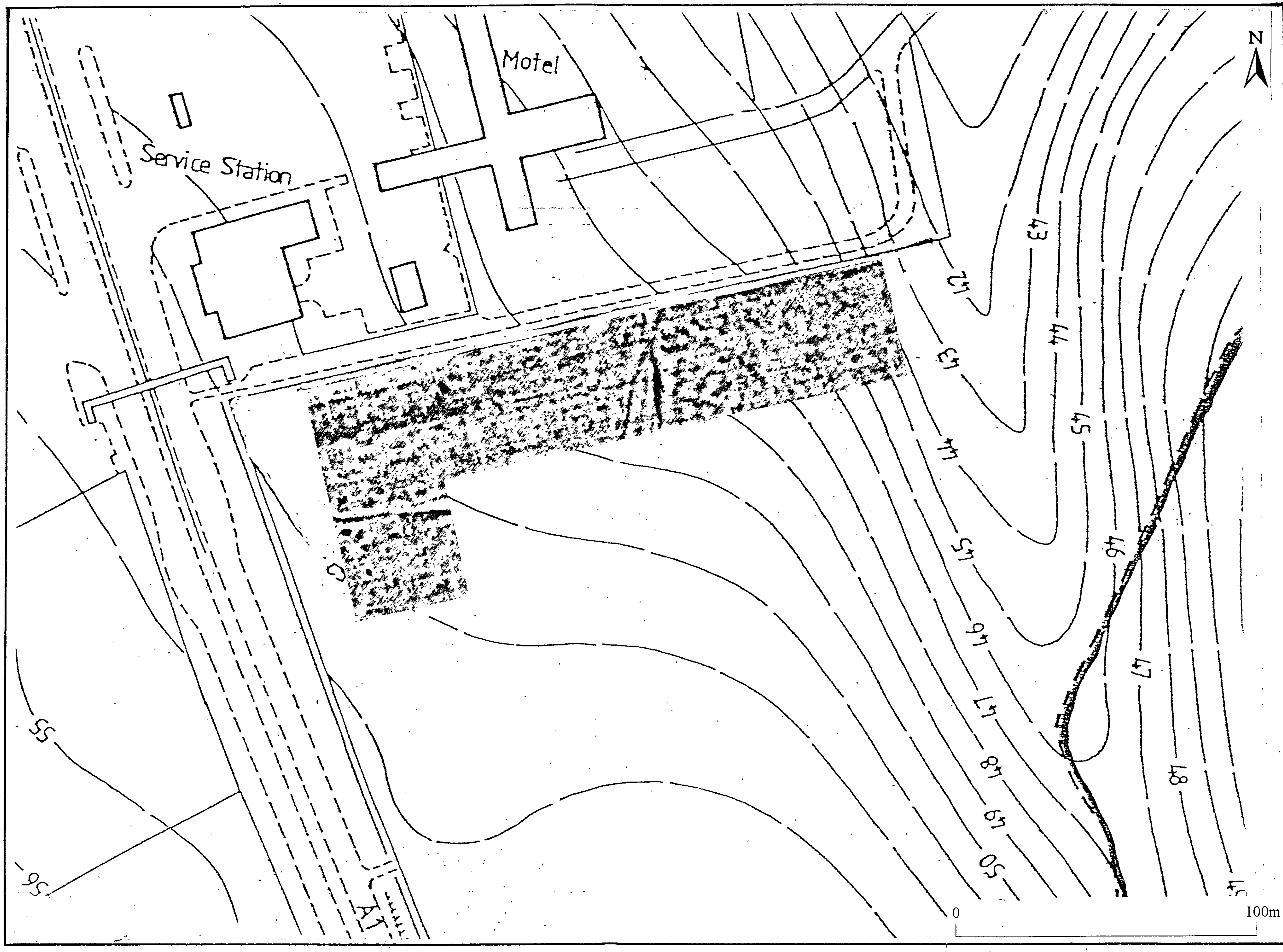

Fig. 2 1:1250 Grey-Scale Plot of Gradiometer Data

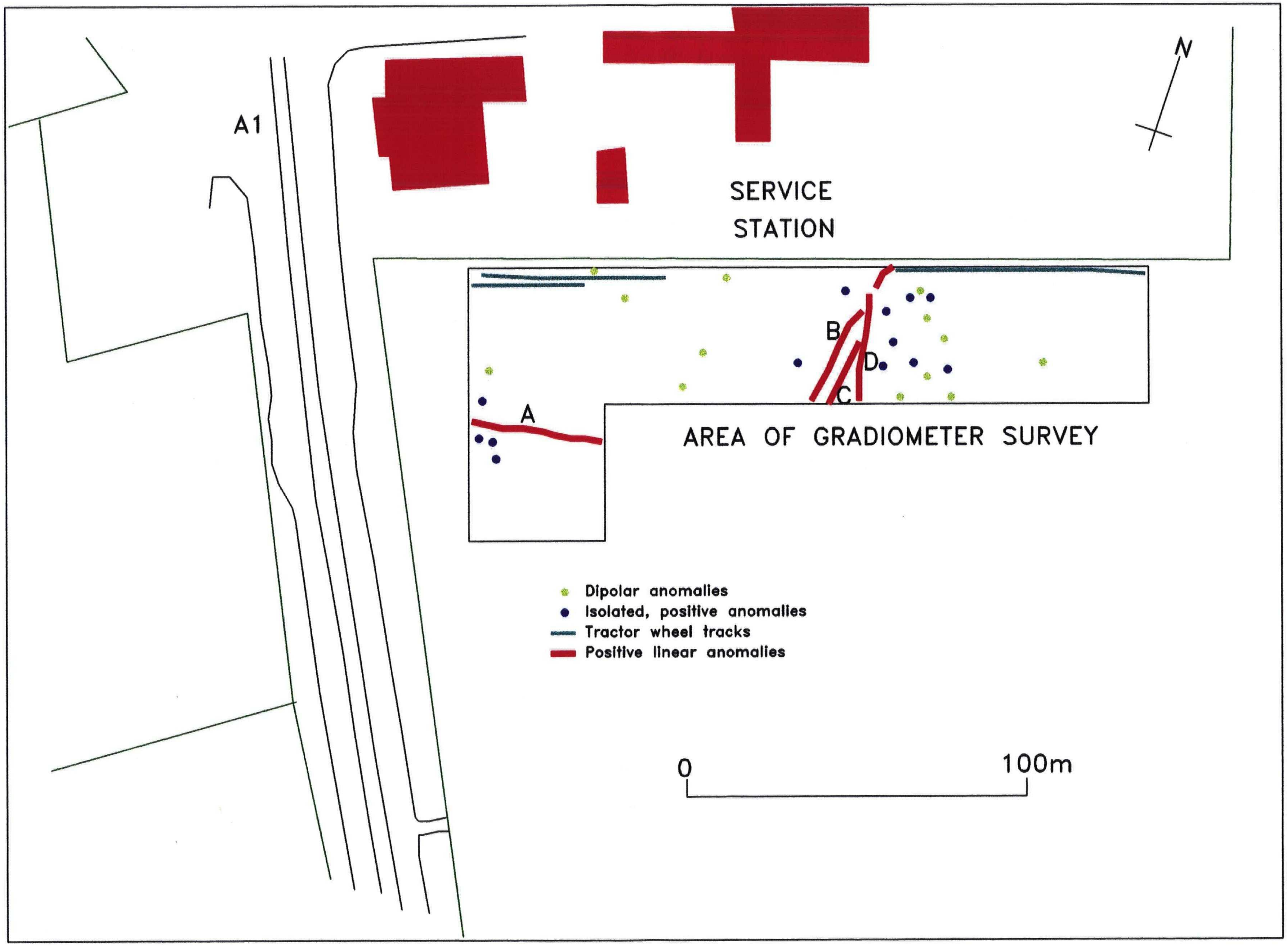

Fig. 3 Interpretation of the gradiometer data

Fig. 3

5. Discussion

5.1 From Figure 1, which shows the current survey together with those completed in 1993 and 1995, it can be seen that the orientation of the anomalies follows the pattern noted previously (Webb, 1995). Anomaly **A** is roughly at right angles to the A1 (the Great North Road) and on the same alignment as current field boundaries and others shown on the 1st edition Ordnance Survey map. This would suggest that Anomaly **A** is probably part of the same field system.

5.2 The parallel anomalies **B** and **C** align with the interpreted double ditched trackway (Anomaly **M** - 1995 survey) although the distance between the ditches is only approximately 4m as compared with 10m for Anomaly **M**. This too is probably a trackway.

5.3 Anomaly **D** is at a slightly oblique angle to the trackway described above but is at right angles to Anomaly **A**. This is probably a ditch forming part of the same field system as Anomaly **A**.

5.4 The intermittent anomalies are caused by tractor wheelings.

5.5 Whilst the responses of the isolated positive anomalies could be indicative of features containing material magnetically enhanced through human activity, *e.g* pits, hearths or kilns, experience of similar responses on the same geology suggests that they are probably fluvo-glacial features.

6. Conclusion

6.1 As in the 1995 survey the positive linear anomalies detected reflect the change in orientation of the field systems over time; the trackway being a different phase to Anomalies **A** and **D** which align with the current field layout. The positive isolated anomalies are probably natural water formed features.

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Graphics	A. Boucher BSc
	September 1996

SNY 11605 1x OVERSIZE PLOT NOT SCANNED

SEE ORIGINAL.